Space Weather Technical Forecast

Issued on Friday, 19 August 2022 at 12:27 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of G1/G2 Minor/Moderate geomagnetic storms days 1 and 2 (19th/20th). Chance of further Moderate flares (R1-R2 Radio blackouts) throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate with two M-class flares observed in the past 24 hours. The largest of which was M1.6 at 19/0444 UTC from AR3078 (Dkc/Beta-Gamma-Delta) in the southwest quadrant. There are eight sunspot regions on the visible disc, including new flux emergence in the east disc however they are generally smaller are simpler than AR3078. AR3078 maintains an unstable and fairly complex magnetic structure. While it does appear to be simplifying and showing some penumbral spread, it and also is approaching the southwest limb where some of the apparent simplification is likely due to reduced viewing angle. This region has produced a couple of CMEs, in the last 24 hours, however these are not expected to be Earth-directed.

Solar Wind / Geomagnetic Activity: The solar wind speed, as measured by DSCOVR at L1, has been elevated to strong, around 550-600km/s with average density as the influence of CH14 fast wind continues, perhaps with ongoing effects of recent CME arrivals. The total magnetic field strength (IMF) Bt, has generally been gradually easing from Moderate to Weak levels, from 11nT to 5nT. The north-south component Bz, fluctuated between +7 nT and -7 nT. The phi angle has largely been negative (towards the sun). Geomagnetic activity was at Minor Storm 18/1200-2400 UTC, then declined to Unsettled to Quiet.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV), as measured by GOES16, was at Background levels. The high energy electron flux (greater than 2 MeV) was at Background to Moderate levels, but has climbed since 19/0450 UTC to peak at 827 pfu by the end of the period. The 24-hour integrated electron fluence was below the Active threshold with 4.47e6 integrated pfu observed at 19/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is likely to be Low to Moderate with further M-class flares likely and a slight chance of an X- class flares, primarily from AR3078 in the southwest quadrant.

Solar Wind / Geomagnetic Activity: Glancing CME arrivals are possible on days 1-2 (19th-20th) from recent CMEs from AR3078. Solar winds are likely to remain elevated through much of this period due to ongoing fast wind from CH14, perhaps declining days 3-4 (21st-22nd), although with further enhancement possible from CH16. Corresponding geomagnetic activity is expected to be Quiet to Unsettled, with a chance of Active to G1/Minor Storm, perhaps G2/Moderate Storm intervals on days 1 and 2 (19th and 20th) from any CME arrival. Towards the end of the period activity is likely to become predominantly Quiet to Unsettled.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is likely to remain at background levels, although there is a slight chance of an S1 or greater event, mainly due to AR3078. High energy electron flux will start will start the period at Background to Moderate levels, with ongoing CME and HSS effects. A rise to Moderate to High levels is likely

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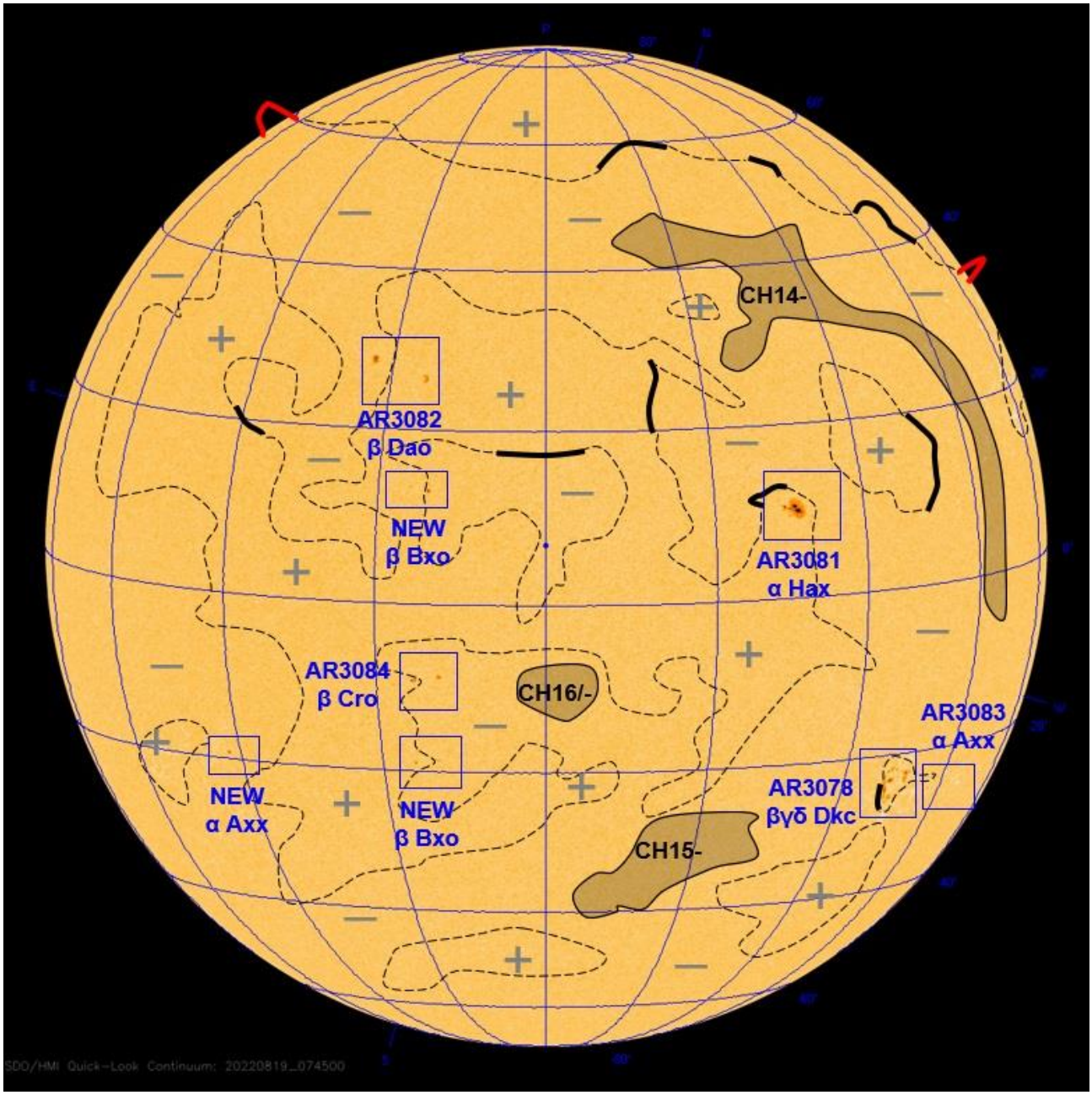
on days 3 and 4 (21st and 22nd) as solar winds ease, however low confidence on the extent of this rise. Electron fluence values are expected to remain below the Active threshold through much of this period. However, an increasing trend is likely from day 3 (21st) with a chance of exceeding the Active threshold on day 4 (22nd).

Figure 1. Solar Analysis Valid 19/0800 UTC.



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Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A series of CMEs have left the southwester quadrant of the Sun over the past few days, primarily from AR3078. The bulk of the ejected material is likely to pass south and ahead of Earth, but there remains a chance of glancing blows at times during days 1 and early day 2 (19th and 20th).

Solar winds are currently elevated as Earth remains within the fast wind from coronal hole 14. These winds are expected persist through days 1-3 (19th until the 21st), perhaps being strong due to any CME arrival, before gradually easing day 4 (22nd). This is relatively low confidence however, due a potential fast wind arrival from the small southern coronal hole CH16, although this is likely to be relatively weak in comparison to current solar winds.

Corresponding geomagnetic activity is expected to be Quiet to Unsettled with Active to G1/Minor Storm, and a chance G2/Moderate Storm intervals on days 1 and 2 (19th and 20th) mainly from any CME arrivals. On days 3 and 4 (21st and 22nd) activity is likely to become mainly Quiet to Unsettled, with a chance of Active intervals, but an ongoing slight chance of G1/Minor storms from any further enhancement from CH16.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	Yes	50	50	10	10
Strong	G3	No	5	5	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
16/0740	Partial	AR3078	South Centre	600	19/0001 +/- 12hours	Not yet observed Glancing blow
17/1430	Partial	AR3078	Southwest	970	19/2100 +/- 12 hours	Glancing blow possible.

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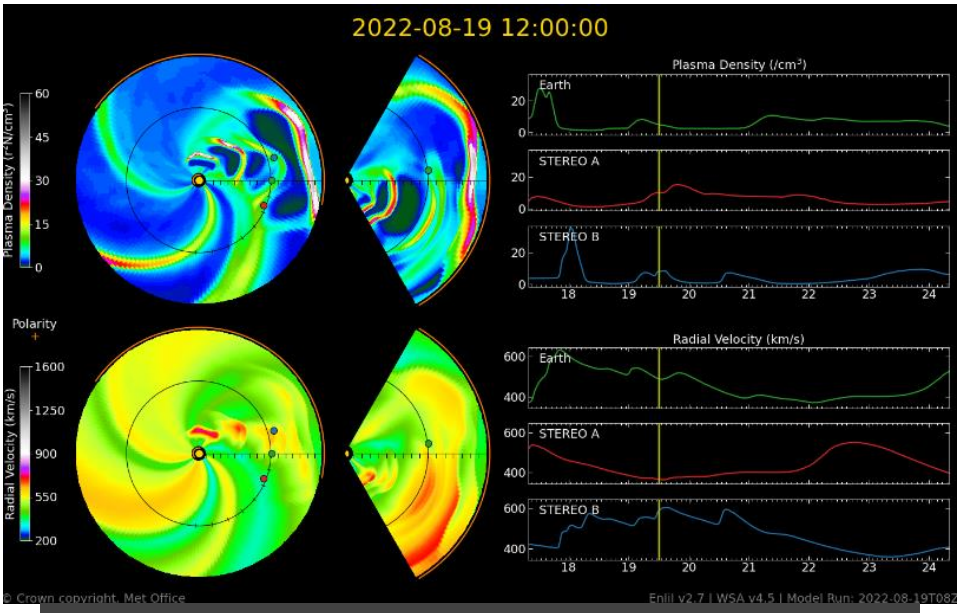
Figure 2: Enlil and Ensemble



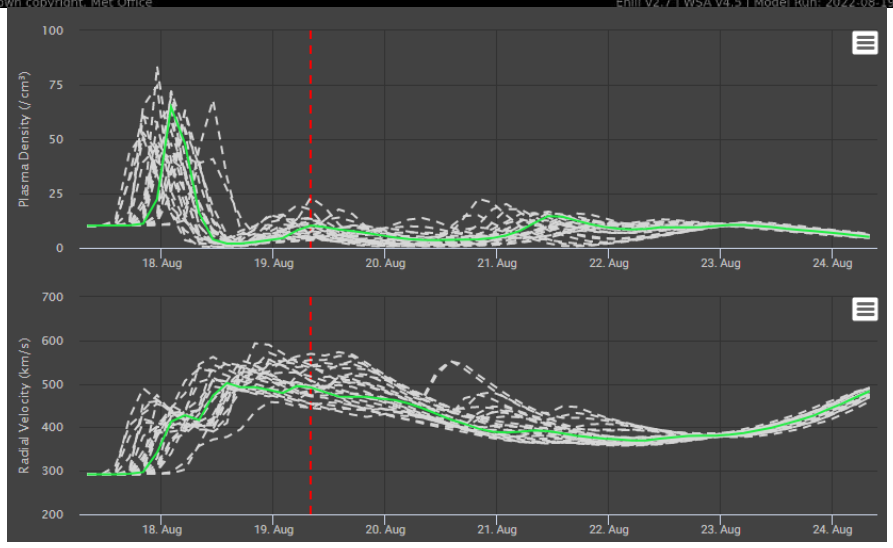
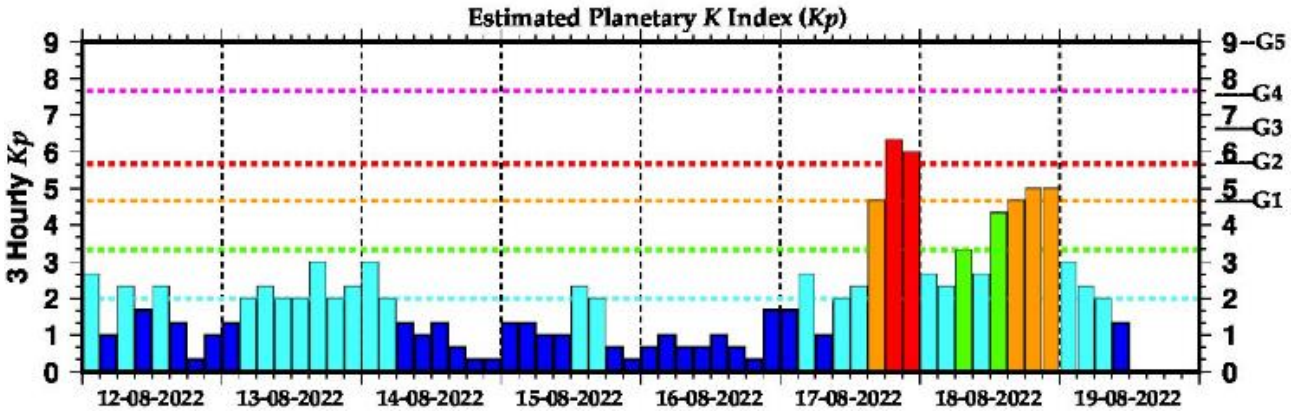


Figure 3: BGS Observed geomagnetic activity



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Radio Blackouts - X-Ray Flares:

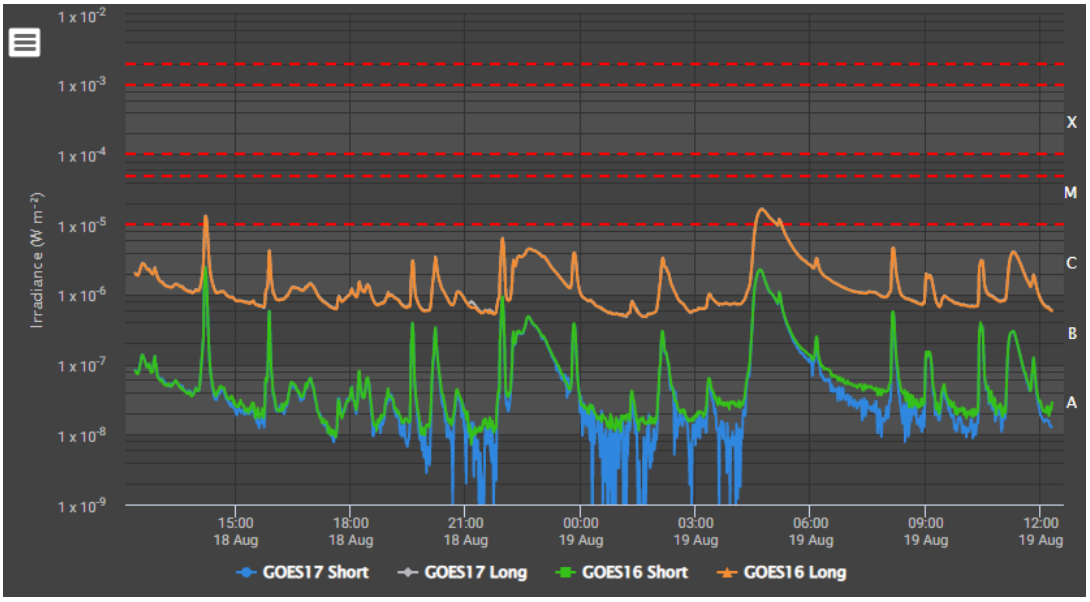
Solar activity is currently Moderate, due to ongoing activity from AR3078 (Dkc/Beta-Gamma-Delta). This is modestly sized, but magnetically complex region that has produced a number of M-flares (R1 Radio Blackouts, with one R2) during its lifetime. Despite appearing to both spread and gradually simplify, this region remains a source of flaring, likely due to complexity that is becoming hidden due to the increasingly poor viewing angle. An ongoing potential for further M-flaring, with a slight chance of X-flares is therefore maintained as this rotates off the disc, only reducing slightly due to uncertainty regards its decay.

There are eight regions on the disc, including a couple of newly emergent areas in the east disc, however these all are much smaller and simpler. Of the remaining sunspots AR3081, (Hax/alpha) whilst recently showing signs of simplifying, has provided the most activity with a recent C-flare.

Activity is likely to remain Moderate, with a chance of falling to Low, but an ongoing slight chance of increasing to High.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	60	50	40	30
Very Active	R3 to R5 X Class	No	10	10	5	5

Figure 4: GOES-16/17 X-ray Flux



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is currently at Background levels, and is likely to remain at this level through the period. However, there is a very slight chance of an S1 or greater event as AR3078 continues its transit across the southwestern quadrant.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	10	10	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy electron flux, as measured by GOES-16, has recovered after recent CME arrivals to Moderate levels, with a chance of reaching High on day 1 (19th). However any potential CME arrivals day 1 and day 2 (19th and 20th) are likely to give further drop out in observed values. More sustained recovery of flux is then likely, as the ongoing fast wind of CH14 gradually eases day 3 (21st) and beyond. However confidence remains low due to uncertainties around the CME arrivals and any potential further solar wind enhancement from the fast wind of CH16/- later in the period.

The associated electron fluence is currently below Active, and is likely to remain at this level day until at least day 3 (21st), and more likely until day 4 (22nd), depending on the extent of any recovery of flux. REFM suggests Active fluence on the 21st, however this would be in the absence of any CME arrival.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	10	30	50
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	5

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Figure 5: GOES 16 >2MeV Electron Flux and Fluence with REFM

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